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COVARIATION WITHIN FUNCTIONAL RESPONSE CLASSES: IMPLICATIONS FOR TREATMENT OF SEVERE PROBLEM BEHAVIOR

JEFFREY R. SPRAGUE AND ROBERT H. HORNER
UNIVERSITY OF OREGON

Two studies examined the effects of a reductive treatment versus instruction-based treatments on the generalized reduction of problem behaviors. Each study involved a detailed analysis of multiple problem behaviors performed by school-aged youth with severe intellectual disabilities. The analysis examined the contrasting effects of one of two different positive intervention procedures (teaching a positive alternative behavior or providing additional teacher assistance during instruction) versus blocking and/or verbally reprimanding a problem behavior. The focus of each analysis was on the covariation of multiple problem behaviors within functional response classes. Results of the investigation indicated that when only one member of the response class was blocked, a collateral increase was observed in one or more different problem behaviors from the same response class. Alternatively, when 1 participant was taught a functionally equivalent mand response, all problem behaviors in the response class were reduced. Problem behaviors also were reduced for the remaining participant by presenting antecedent teacher assistance. Implications of the research extend to analysis of covariation within response classes and to procedures that result in generalized reduction of problem behaviors within a response class.

DESCRIPTORS: competing response, functional analysis, matching law, response class, response covariation

Response covariation refers to changes in the probability of one behavior being emitted as a function of changes in the probability of other behaviors. Response covariation is relevant for designing proactive treatments to reduce serious problem behaviors (Parrish, Cataldo, Kolko, Neef, & Egel, 1986) and is based on three compatible lines of research. First, response covariation can occur as a function of the matching law (Davison & McCarthy, 1988; Herrnstein, 1970). The matching law predicts the relative probability of multiple responses based on the frequency of reinforcement associated with each response. The matching law provides a mathematical model for predicting the covariation of multiple responses and has direct implications for clinical treatment of complex problem behaviors (e.g., Epling & Pierce, 1990; Mace, McCurdy, & Quigley, 1990; McDowell, 1988; Myerson & Hale, 1984). Recent applications of the matching law in applied contexts have emphasized the need to assess both the comparative frequency of reinforcement available for different responses and the requirements (e.g., efficiency) of the different responses (Horner & Day, 1991; Mace et al., 1990).

A second compatible line of research is behavioral allocation. Regardless of the consequences of a behavior, there is a limit to the number of responses a person can emit during a specified time period. Increases in the time spent performing one behavior result in decreases in the time available to perform other behaviors (Cataldo, Ward, Russo, Riordan, & Bennett, 1986; Fisher, Piazza, Cataldo, & Harrell, 1990; Parrish et al., 1986). Like research on the matching law, behavioral allocation has emphasized that many different factors may affect the covariation of responses, including the decrease in opportunity to perform one behavior given the frequency of occurrence of an alternative behavior.

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Address correspondence and reprint requests to Jeffrey Sprague, 2853 East 10th Street, Indiana University, Bloomington, Indiana 47405.

A third area of research is functional equivalence training (Carr, 1988). Functional equivalence training is based on functional analyses of problem behavior that result in documentation of stimulus events that guide and maintain the behavior (Bijou & Baer, 1961; Bijou, Peterson, & Ault, 1968). A new behavior resulting in the same consequence as the problem behavior is taught and will compete successfully if the assumptions of the matching law and behavioral allocation are met. Empirical support for the predicted covariation associated with functional equivalence training is impressive (e.g., Durand & Crimmins, 1987; Horner & Budd, 1985; Horner, Sprague, O'Brien, & Heathfield, 1990; Wacker et al., 1990).

The present study extended the analysis of variables affecting response covariation by evaluating the multiple effects of treatment across different behaviors due to collateral changes within functional response classes. A response class is a set of topographically different behaviors that produce the same functional effect (Johnston & Pennypacker, 1980; Millenson & Leslie, 1979). Members of a response class are predicted to covary as consequences associated with individual members of that response class change. Thus, procedures that reduce a single member of a response class should produce collateral effects on other members of the response class (Dunham & Grantmyre, 1982; Parrish et al., 1986).

Our specific interest was in the collateral effects of a treatment that decreases one undesirable behavior in a response class relative to an intervention that reduces all undesirable members. In two studies, a functional assessment was conducted (a) to document that a class or problem responses existed and (b) to identify the consequences maintaining the members of the response class. In both studies, the initial phases provided empirical documentation that the identified class of problem behaviors was maintained by a common consequence, and manipulation of that consequence resulted in covariation of all members of the response class. Study 1 examined effects of both blocking or reprimanding one problem response and functional equivalence training. Study 2 compared effects of blocking or reprimanding versus adding antecedent teacher assistance on the covariation of all members of the response class.

GENERAL METHOD

Participants and Setting

One adolescent participated in each study. Alan was 15 years old at the start of the study and had mild athetoid cerebral palsy. According to his school records, he was functioning in the moderate range of mental retardation. He lived at home and attended school in a self-contained special education classroom but received some instruction in general education environments. Alan was not taking any medications at the time of the study.

The behaviors of concern for Alan were described as tantrums. Clinical data provided by classroom staff indicated that the tantrums occurred up to five times per day at school and less often at home. The tantrums included hitting others, head and body shaking, hitting objects, putting hands to face, and screaming.

Barbara was 12 years old, lived with her parents, and carried diagnoses of autism and severe mental retardation. She attended a self-contained classroom for students with severe intellectual disabilities in a regular public middle school. She spoke in simple one- to two-word sentences but was difficult to understand.

Behaviors of concern for Barbara included putting her head on the table, screaming, putting her fingers in her ears or mouth, hitting or kicking objects, hitting herself, flapping her hands, hitting or kicking others, and pulling up her shirt. Clinical data provided by classroom staff indicated that she performed these behaviors five to 50 times per day and less often at home. Her behaviors were judged to be sufficiently severe that she was temporarily removed from her school program prior to the study.

Observation, training, and probe sessions were conducted during regular instructional periods in the classrooms and other learning environments in

the school (e.g., adjacent areas such as cafeterias and gymnasiums).

Preexperiment Assessment

Prior to implementation of the individual studies, a functional assessment interview (O'Neill, Horner, Albin, Storey, & Sprague, 1990) was conducted with the teacher(s) of each student. In addition, the senior author spent 6 to 10 hr in direct observation of each participant to supplement and validate the information obtained from the interviews. The purpose of the interview and observation was to gain information about the specific problem behaviors, possible discriminative stimuli, and maintaining consequences. The information obtained from this assessment was used to determine the target behaviors, to develop hypotheses regarding the function of the problem behavior(s), and to determine the format of the subsequent functional analysis and intervention.

Measurement

Different behaviors were assessed in each study. Videotapes were made of all sessions, which were conducted three to four times per week and lasted 15 to 20 min. Observers reviewed each tape using Toshiba Model 1000 microcomputers and observation software developed by Repp, Harman, Felce, Van Acker, and Karsh (1989). This software allowed documentation of the frequency and duration of each behavior and the interrelations of each behavior in real time. Three categories of behaviors were monitored: (a) problem behavior, (b) desirable behavior, and (c) teacher behavior. For problem and desirable behaviors, frequencies per minute were recorded; for desirable behavior, the percentage of trials correct without assistance was also recorded. For teacher behavior, frequency per minute of the following were recorded for each participant: (a) reprimands, (b) praise, (c) instruction to perform an easy task, (d) instruction to perform a difficult task, (e) physical blocks of student behavior, and (f) antecedent prompts. These variables were recorded concurrently with the participant behaviors and subjected to the same reliability assessments. Definitions of all behaviors are available from the first author.

Interobserver Agreement

Three graduate students in special education served as observers throughout the two studies. Observers received instruction from the first author on the observation protocol and behavior definitions and were required to achieve an agreement score of 80% or higher in practice coding sessions with a standard observer prior to implementation of the studies. Two observers rated the videotapes during 38% of the sessions in Study 1 and 33% of the sessions in Study 2. Interobserver agreement was computed for each measurement variable using the "Reliable" program developed by Repp et al. (1989) with a window of ± 3 s. The interobserver agreement for each variable reported for each student and the teacher averaged 86% or higher (range, 79% to 99%) across all phases. Tables listing the interobserver agreement mean and range for each variable for each phase per participant are available from the first author.

STUDY 1: EFFECTS OF BLOCKING OR REPRIMANDING AND FUNCTIONAL EQUIVALENCE TRAINING ON INTRARESPONSE CLASS COVARIATION

Method

The first study was completed with Alan. The prestudy assessment indicated that Alan was most likely to engage in problem behaviors when presented with tasks difficult for him to complete without teacher assistance. Further, the assessment led to the hypothesis that problem behaviors were maintained by access to teacher assistance, with the additional assistance resulting in making the tasks easier (negative reinforcement).

Design and Procedures

The procedures were designed to provide three distinct analyses. The first four phases provided an ABAB reversal analysis of the above hypothesis and permitted inspection of the degree of covari-

ation among the multiple problem behaviors. Second, a BCB reversal analysis was conducted to assess the effects of a physical block and reprimand on one response compared to the other nonblocked members of the response class. Third, a BDB'DE analysis assessed the effects of functional equivalence training on all members of the targeted response class. The full study resulted in an ABABCBDB'DE design with the following procedures per phase.

Easy (A). The easy phases involved training with a set of tasks that were easy for Alan to perform (e.g., counting coins, counting whole dollars, computer learning activities, and collating and stapling). Easy tasks were recommended by Alan's teacher and were defined as tasks that he could complete correctly on at least 75% of the trials within a session. The trainer presented a task with the request to initiate completion. If Alan performed any of the identified problem behaviors, additional trainer assistance was provided in the form of verbal and gestural prompts and modeling. If Alan initiated the task or completed the task successfully, he received verbal praise. If Alan asked for help (e.g., said "help" or "please help"), the teacher provided the same additional assistance that followed performance of problem behaviors.

Difficult (B/B'). The difficult phases replicated the procedures in the easy phases except the tasks were selected by the teacher as being difficult for Alan to complete without assistance. A task was defined as difficult if Alan performed no more than 33% of the trials correctly without assistance during a session.

The second difficult (B') phase was slightly different because Alan had received training to ask for help. If he requested help during this phase, he was told, "Do the best you can." All other procedures replicated those of the previous difficult phase.

Difficult plus reprimand and blocking (C). The procedures for this phase replicated those of the difficult (B) phases except when Alan "hit out" (without hitting a person or object), the teacher (a) physically blocked his response, (b) delivered a mild verbal reprimand (e.g., "stop that"), and (c) presented the task again. If Alan verbally requested help, the teacher provided assistance.

Functional equivalence training (D). During this phase, the functional equivalence procedures recommended by Carr (1988) and Durand (1990) were applied. An alternative socially acceptable behavior (verbally asking for help) was taught. Alan already had the ability to say "help." Training involved four 10-min sessions (a total of 80 trials) during which the word "help" or "help please" was prompted when Alan arrived at a step in the task that previously had been difficult. When Alan performed with 90% accuracy without prompting across two sessions, the functional equivalence (D) training procedures were introduced.

Functional equivalence follow-up (E). Two months after the last functional equivalence session (Session 36), three follow-up sessions were conducted. These sessions replicated the functional equivalence training procedures except that prompting to ask for help was limited to the beginning of the first session.

Results and Discussion

The results for Study 1 are provided in Figure 1. The top panel presents the frequency for all problem behaviors in the defined response class and the frequency of the blocked response (hitting out). The bottom panel presents the frequency of the two adaptive participant behaviors, task-related verbalizations and requests for help. Separate graphs for each behavior are available from the first author.

Data on the first four phases presented in the top panel of Figure 1 support the hypothesis that problem behavior was maintained by escape from difficult tasks. In addition, the behaviors covaried across phases. The exceptions were putting hand to face and requesting help. Phases 4 through 6 of the study assessed the impact of verbal reprimands plus blocking following the hitting-out response. The results across all problem behaviors are displayed in the top panel of Figure 1 and indicate no decrease in total problem behavior, although a substantial decrease in hitting out occurred. Four responses (head/body shake, hit objects, hands to face, and scream) increased in frequency during the

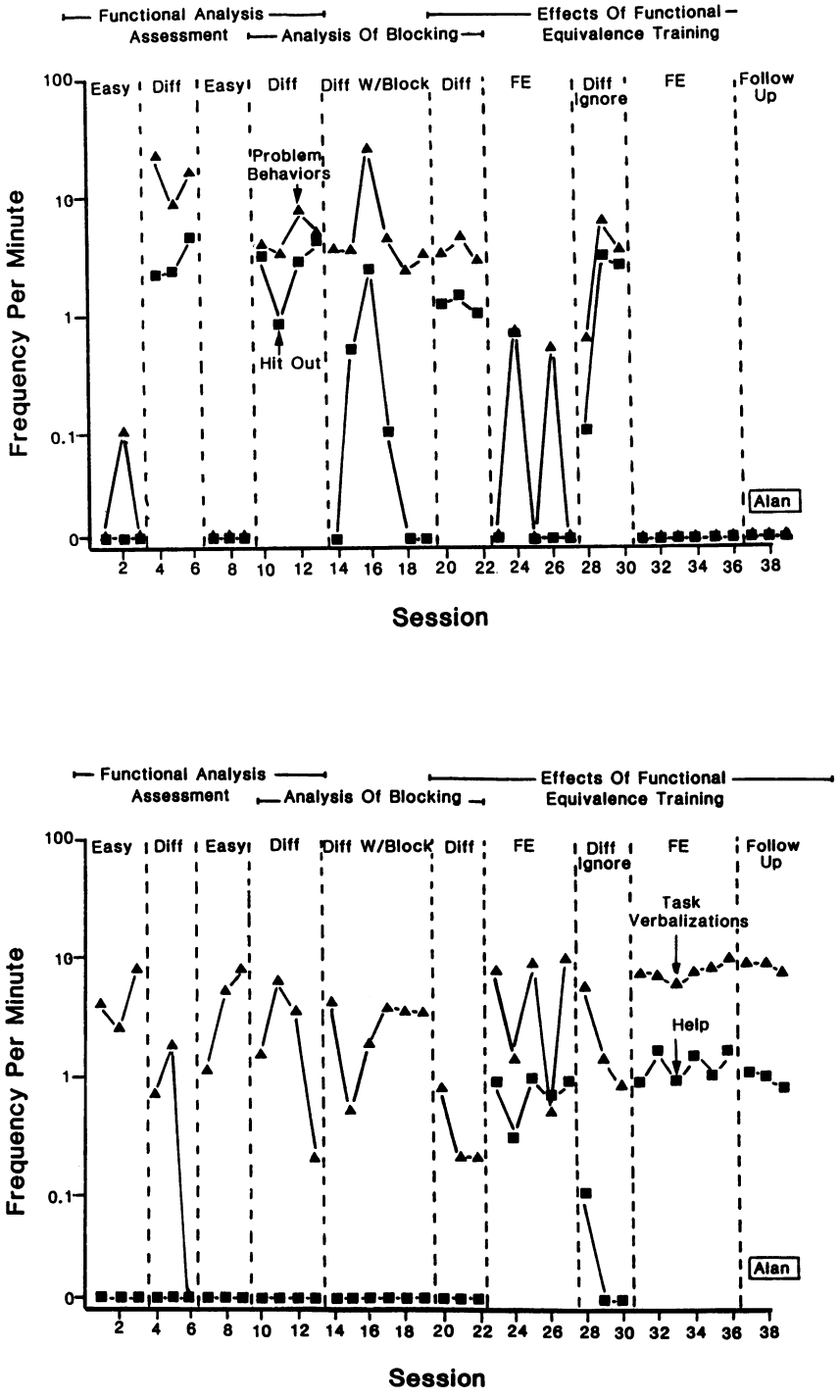

Figure 1. Frequency (per minute) of total problem behaviors and "hit out," task-related verbalizations, and help requests for Alan as a function of task difficulty, blocking and reprimanding, and functional equivalence training.

block/reprimand phase and decreased when block/reprimand was discontinued. Hitting others occurred at zero or near-zero frequencies across the three phases and did not show a change when the block/reprimand intervention was introduced. Alan also continued his pattern of not using any verbal requests for help during the three phases.

After training, Alan requested "help" regularly throughout the remaining functional equivalence and follow-up phases at a frequency of approximately one request per minute. Phases 6 through 10 provided a reversal design to assess the effect of using "help" on problem behaviors. The results indicated that problem behaviors were much less likely when the "help" response was used than during the difficult phases when "help" was not used or was ignored.

It is important to note that during the first difficult phase in this analysis, Alan did not use a "help" request. To determine whether rewarding "help" with teacher assistance was the effective component of this intervention, the difficult (B′) phase included a change in protocol. If Alan asked for help he was told, "Do the best you can." In essence, this phase involved removal of the assistance believed to be the functional reinforcer for saying "help." When saying "help" did not lead to assistance but problem behavior did, there was an immediate increase in the frequency of problem behavior. With reintroduction of the functional equivalence procedures, Alan completely stopped performing problem behaviors. This pattern was maintained during the three follow-up sessions conducted 2 months later.

The data in Figure 1 provide evidence that the reduction of problem behaviors following functional equivalence training and increases in problem behavior during difficult (B′) instruction were consistent across all problem behaviors except screaming (which was not observed during any session in Phases 6 through 10). Thus, functional equivalence training appeared to be functionally related to a collateral reduction in all observed problem behaviors in the targeted response class.

Teacher praise was delivered at similar levels across the easy (M = 3.4 per minute), difficult (M = 3.2 per minute), and functional equivalence (M = 4.2 per minute) phases. A potential confounding effect existed in that teacher praise was observed at a slightly lower level during the block/reprimand phase (M = 2.0 per minute). The mean frequency of teacher prompts was 7.7 per minute in easy, 7.6 per minute in difficult, 7.4 per minute in block/reprimand, and 7.3 per minute in functional equivalence phases. The mean percentage of trails correct per session was consistent with the criteria for easy (95%), difficult (33%), and functional equivalence (25%) sessions.

STUDY 2: ANALYSIS OF BLOCKING AND ANTECEDENT ASSISTANCE TRAINING ON INTRARESPONSE CLASS COVARIATION

Method

The results from Study 1 demonstrated that multiple behaviors were maintained by escape from difficult tasks and that a reduction in the blocked behavior resulted in a reduction in that behavior and a collateral increase in other behaviors. Further, a reduction in all problem behaviors was observed following functional equivalence training with a collateral increase in the "help please" response. These results provided a demonstration of the collateral effects of a reductive technique versus a teaching technique. Study 2 was designed to investigate the collateral effects of an alternative antecedent assistance intervention and to replicate the effects of the blocking intervention in Study 1.

The initial assessment interview and observation process suggested that Barbara used problem behaviors to achieve a variety of behavioral functions including escape from task demands and access to attention. The teaching staff and her parents also suggested that she used problem behaviors to gain additional assistance from her trainers during instruction, thereby making instruction easier and less aversive. Using problem behaviors to get additional assistance became the focus of the investigation.

Design and Procedures

An ABA reversal was conducted to assess the existence of a response class and to support the

hypothesis that contingent access to teacher assistance was a reinforcer for members of the response class. This was followed by a CBC analysis to assess the effects of blocking plus a verbal reprimand on a single response class member and on other members of the response class. The full study resulted in an ABACBCA reversal design.

Antecedent assistance (A). Barbara was presented with a series of difficult coin- and money-counting tasks. Antecedent assistance was defined as a trainer model of the correct response immediately following the presentation of the target task cue. For example, the trainer presented four $1 bills to Barbara and said, "Count the dollars." Immediately following the initial cue, the trainer modeled the correct response and said, "Watch me. One, two, three, four. Now you do it!" Barbara then attempted to complete the task. If she failed to complete the task, assistance was repeated, and verbal and physical reinforcement (tickling) were delivered for correct responses and attempts to respond. If Barbara emitted a problem behavior during this phase, the teacher paused and repeated the previous instruction. If Barbara asked for help, assistance was provided immediately.

Contingent assistance (B). This condition presented the same difficult instructional tasks, but antecedent assistance was not provided. The contingent assistance condition stipulated that Barbara perform either a targeted problem behavior or ask for help in order to gain assistance. For example, the trainer presented four $1 bills to Barbara and said, "Count the dollars." The trainer waited 5 s and repeated the cue if no response was made. If no response was emitted within another 5 s, the cue was delivered a third time. If still no response occurred at this point, the trainer presented the next instructional task. If Barbara emitted a problem behavior or asked for help, the trainer immediately delivered the assistance. Praise for correct responding and response attempts was delivered exactly as in the antecedent assistance phase.

Contingent assistance plus blocking (C). This phase replicated the procedures in the contingent assistance phase, except "head to table" was physically blocked and followed by the author stating, "Don't do that," or "Stop that," in a flat voice tone. If Barbara verbally requested help, the trainer provided assistance.

Results

The results of Study 2 are provided in Figure 2. The top panel presents the frequency of all problem behaviors in the identified response class and the frequency of the blocked response (head to table). The bottom panel depicts the frequency task-related verbalizations and requests for assistance (help).

The results from the functional analysis assessment showed that the frequency of targeted problem behaviors remained relatively low or nonexistent under the two antecedent assistance conditions (M = 0.13 and 0.27 per minute, respectively), but when access to assistance was made contingent on the performance of a problem behavior, an immediate increase in frequency was observed (M = 2.55 per minute). The anticipated reversal pattern was observed for putting head on table, hitting or kicking objects, screaming or crying, fingers in ears or mouth, and flapping hands, but hitting self did not decrease during the second antecedent assistance phase and kicking or hitting others and pulling up shirt were not observed. Barbara requested assistance at a slightly higher frequency during contingent assistance, and requests for help also appeared to display a positive covariation with the frequency of problem behaviors.

The effects of the block and reprimand intervention on head on table are presented in the top panel of Figure 2. When head on table was followed by a verbal reprimand and physical block, the frequency of behavior was lower than when reprimand and blocking were not used (block M = 0.02 per minute; no block M = 0.43 per minute; block M = 0.10 per minute). Although the intervention was effective at reducing the targeted problem behavior, the effect was less clear when assessing the full class of problem behaviors. The results for all problem behaviors (top panel of Figure 2) showed no reduction in total frequencies of problem behavior when blocking and reprimands were used. An analysis of all behaviors indicated that although frequencies of head on table de-

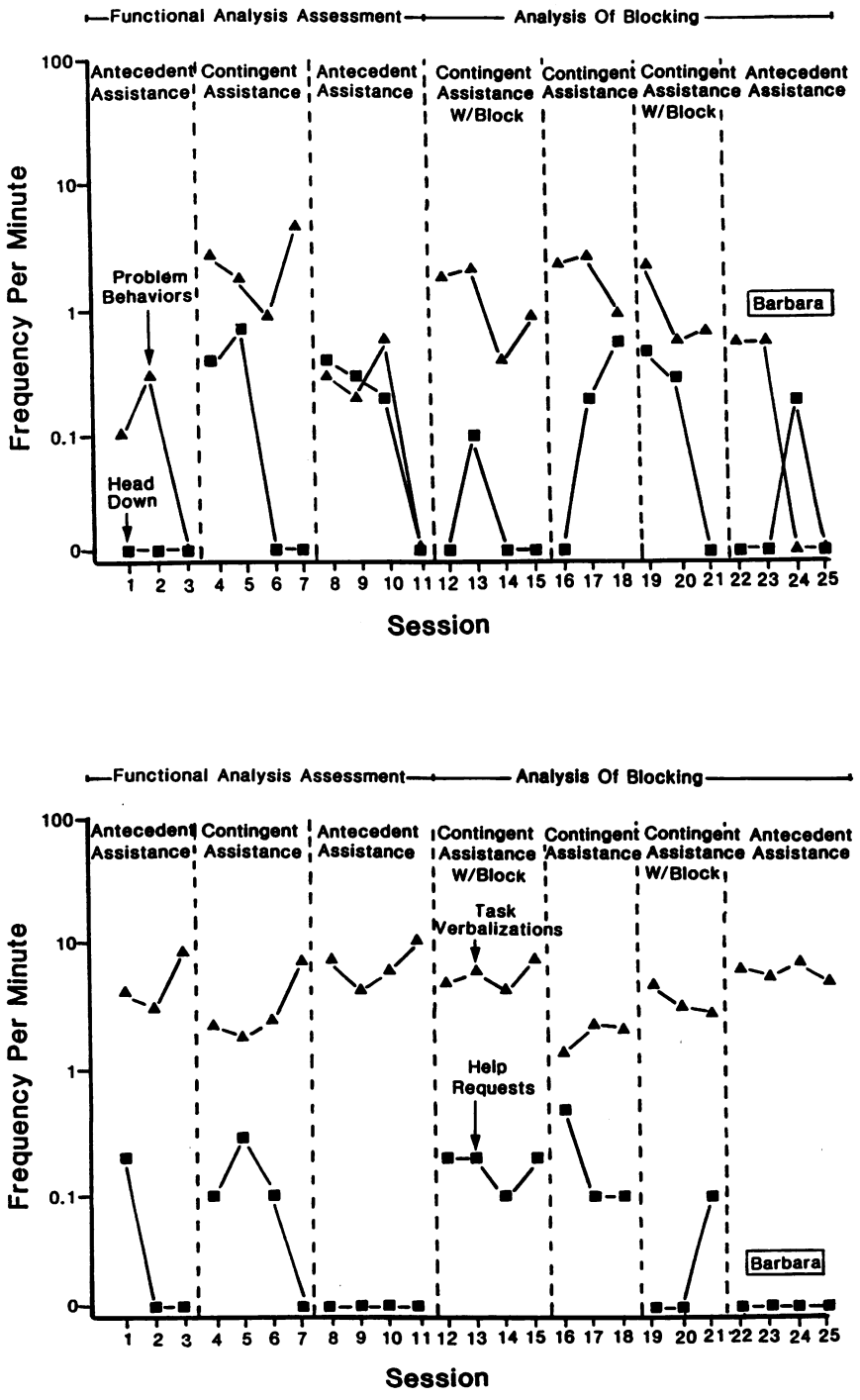

Figure 2. Frequency (per minute) of total problem behaviors, "head on table," task-related verbalizations, and help requests for Barbara as a function of contingent versus antecedent assistance and contingent assistance with blocking and reprimands.

creased when block and reprimand were applied, other responses in the class increased.

The frequency of Barbara's task-related verbalizations decreased slowly over the CBC reversal (contingent assistance with blocking, contingent assistance, contingent assistance with blocking) from an average of 6.5 per minute in the first block phase, 3.8 per minute in contingent assistance, to 3.3 per minute in the block replication. Requests for help were observed at an average of 0.18 per minute in the first block phase, 0.23 per minute in the return to contingent assistance, and 0.03 per minute in the block replication. The final phase of the study was a return to antecedent assistance. This manipulation resulted in rapid reduction of all problem behaviors except hitting or kicking objects, which gradually declined to zero.

Teacher praise and verbal requests were monitored across all phases to assess potential confounding effects. Teacher praise occurred at an average frequency of 3.5 per minute during antecedent assistance, 2.15 per minute during contingent assistance, and 2.45 per minute during contingent assistance plus block. Teacher requests occurred at an average of 4.62 per minute during antecedent assistance, 5.0 per minute during contingent assistance, and 4.68 per minute during contingent assistance plus block.

GENERAL DISCUSSION

This study analyzed how individual responses covary when a subset of the responses in a response class is manipulated. Specifically, each study documented the collateral effects of blocking one member of that class. In each case, blocking one problem behavior resulted in a decrease in the frequency of that problem behavior and a collateral increase in other problem behaviors in the same response class. In addition, collateral decreases of all measured problem behaviors occurred in Study 1 when an alternative intervention that taught a more acceptable but functionally equivalent response was implemented. This finding replicated those of Carr and others (Carr, 1988; Carr & Kemp, 1989; Durand & Carr, 1987, Durand & Crimmins, 1987), who demonstrated reductions in problem behavior by teaching new responses that served the same function as the undesirable behavior. Further, the results replicated previous studies of covariation within functional response classes (Cataldo et al., 1986; Parrish et al., 1986; Russo, Cataldo, & Cushing, 1981).

Multiple mechanisms of response covariation appeared to be responsible for the observed effects. In Study 1, a competing behavior (asking for help) was developed that resulted in the same consequence as the problem behaviors (obtain teacher assistance). The response "ask for help" became a member of the targeted response class. Variables such as the value of the competing reinforcers, the dimensions of the competing reinforcement schedules, the physical effort of the competing responses, and the comparative time delay between the discriminative stimulus and the reinforcer may have influenced the observed reallocation from problem members of the response class to asking for help (Epling & Pierce, 1990; Horner & Day, 1991; Mace et al., 1990; Newsom, Favell, & Rincover, 1983). The antecedent delivery of teacher assistance in Study 2 systematically altered specific controlling events and, thus, may have changed the behavioral allocation from problem to appropriate responses (Cataldo et al., 1986; Fisher et al., 1990; Parrish et al., 1986). It is also possible that teacher antecedent assistance (modeling) functioned as both a discriminative stimulus for reinforcement and a conditioned reinforcer for the performance of task-related behavior (Parrish et al., 1986; Neef, Shafer, Egel, Cataldo, & Parrish, 1983), although a component analysis of this effect was not conducted.

This study is best considered preliminary for a number of reasons. As mentioned above, individual component analyses were not conducted for any of the interventions. Blending components made it impossible to identify the active variables (e.g., verbal reprimands, physical blocking, or redirection) or the underlying behavioral mechanism (e.g., punishment, extinction, or negative reinforcement). The specific factors affecting the observed collateral

effects were not experimentally manipulated, and the magnitude of the response covariation was much clearer for Alan than for Barbara.

Of most importance, this study provided additional evidence that caution should be taken when designing behavioral interventions for individual problem behaviors. Instruction-based interventions may produce different collateral effects within a response class than reductive approaches, and differential effects are likely to be observed across treatments and individuals (Cowdery, Iwata, & Pace, 1990; Parrish et al., 1986). Methodologies that monitor multiple individual target behaviors are necessary to document these effects (Dunham & Grantmyre, 1982; Green & Streifel, 1988), thus, the increased study of multiple treatment effects is warranted. The more information collected on a class of behaviors via systematic functional analysis, the better our predictions should be regarding the overall effects of treatment on individual responding.

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